

**C-A Guidance Document**  
**Review of Seismic Hazard Evaluation Documentation**

December 10, 2002

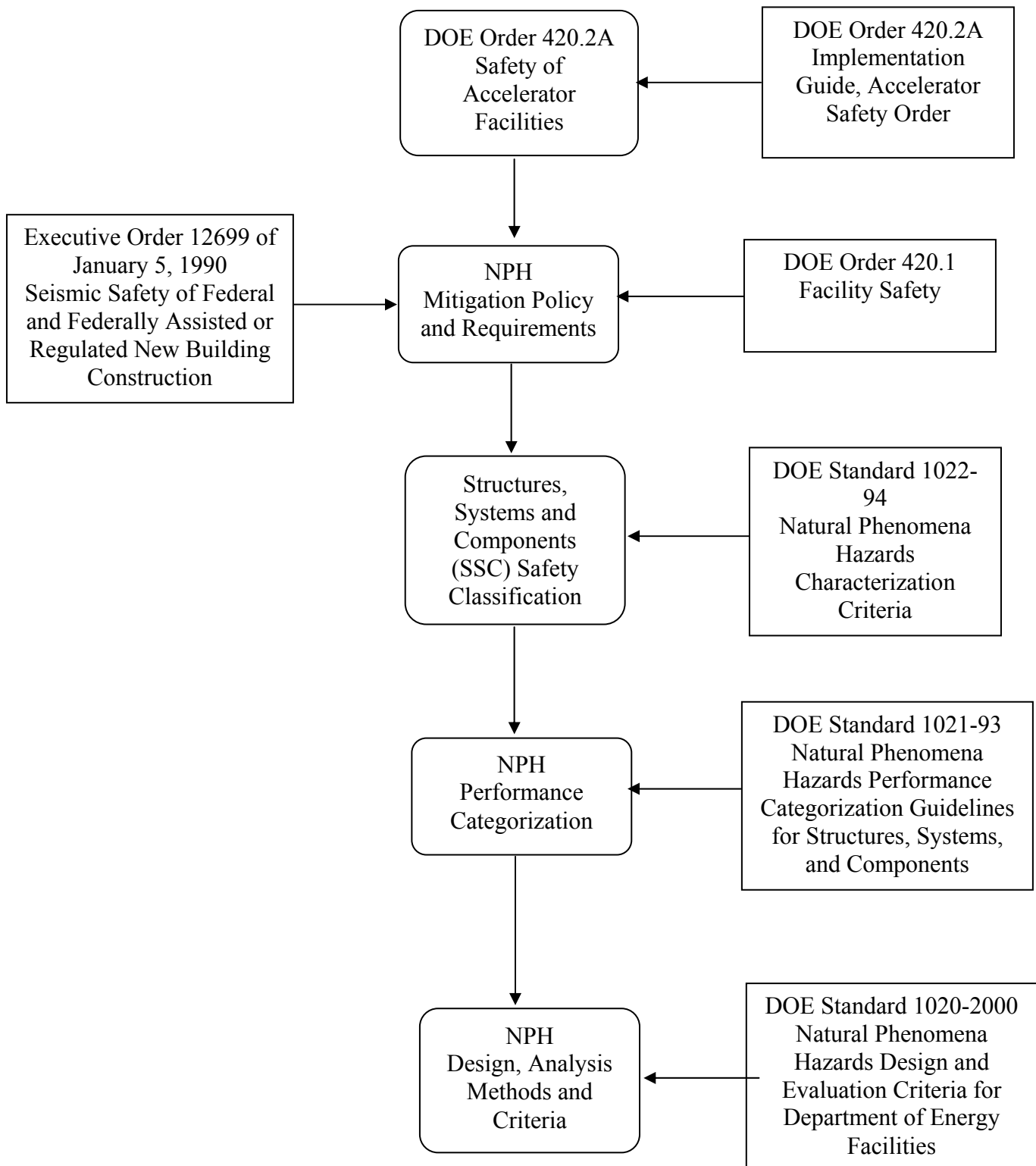
A review of the various DOE orders, standards and guidelines concerning seismic hazard evaluation and mitigation was completed to determine C-A's responsibility to meet the requirements of these various policies. The flow chart on the following page illustrates the various requirements of the DOE, beginning with the Safety of Accelerator Facilities Order. This document is supported by the subsequent references to ascertain the responsibilities of the C-A facility in meeting the requirements of DOE. The outline provided for each document has salient points drawn from the documents. Bold-faced categories align with the central categories of the flow chart. Suppositions based upon interpretation of these documents are also included in this outline in italicized print.

The following conclusions are based upon review of the DOE documents, Laboratory and Departmental seismic hazard safety evaluations.

- Doe Order 1022-94 and DOE Standard 1023-93 provide for seismic hazard categorization of Structures, Systems and Components (SSCs) of the facility. Commensurate with a graded approach to the facility, a Performance Category of PC-1 would be sufficient to describe the design criteria for the facility.
- Adherence to the current building codes (equivalent of Uniform Building Codes for the region) during the construction of structures, systems and components (SSCs) , and being constructed of good – quality materials and having structural parts securely tied together and anchored to the foundation, provides appropriate seismic hazard mitigation to comply with requirements of DOE order 420.1, Facility Safety.
- The C-A complex has been constructed over a period of years. During this construction, techniques were used to assure compliance to the building codes, providing for consideration of seismic hazards.

Peter Cirnigliaro  
December 10, 2002

## **Flow Down of DOE Facility Requirements for Assessment of Natural Phenomena Hazards**



## **Outline of DOE Documents Related to Facility Safety Concerning Natural Phenomena Hazards**

### **Accelerator Safety Order, Doe Order 420.2A Implementation Guide.**

The SAD shall include or reference a description of facility function, location and management organization in addition to details of major facility components and their operation (pg. 10, paragraph 2).

A separate SAD is not required for an accelerator facility module where the risks are adequately addressed in the documented safety analysis of another operation, because of the integral contribution of the module to that operation (pg 10, paragraph 5). *In the future, a site wide document to address Natural Phenomena Hazards (NPH), e.g., Standard Based Management System (SBMS) to be used as a reference in the SAD would be useful.*

### **Chapter 3: Site, Facility and Operation Description**

The function of this chapter is to depict accurately the environment within which the facility will be constructed, the facility characteristics that are safety-related and the methods to be used in operating the accelerator and associated equipment. The following items should be addressed in this chapter:

Characterize the accelerator site location, including any special site requirements or unusual design criteria. Data typically addresses site geography, seismology, meteorology, hydrology, demography and adjacent facilities, which may impact or be impacted by the accelerator facility.

### **Natural Phenomena Hazards (NPH) Mitigation Policy and Requirements.**

DOE Order 420.1 Facility Safety, objective:

The objective of this order is to establish facility safety requirements related to: Nuclear safety design, criticality safety, fire protection and natural phenomena hazards mitigation.

### **Section 4.4 Natural Phenomena Hazards Mitigation**

The objectives of this section are to ensure that all DOE facilities are designed, constructed and operated so that the public, workers and the environment are protected from the impact of Natural Phenomena Hazards.

#### Section 4.4.2 Natural Phenomena Mitigation Design Requirements

Systems, Structures and Components (SSC) shall be designed, constructed and operated to withstand the effects of natural phenomena as necessary to ensure the confinement of hazardous material, the operation of essential facilities, the protection of government property and the protection of life safety for occupants of DOE buildings. The design process shall consider potential damage and failure of systems, structures and components due to both direct and indirect natural phenomena effects, including common cause effects and interactions from failures of other systems, structures, and components. Furthermore, the seismic requirements of Executive Order 12699 shall be addressed. *EO 12699 Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction.*

#### Section 4.4.3 Evaluation and Upgrade of Existing Facilities

Systems, structures and components in existing DOE facilities shall be evaluated in accordance with section 4.4.2 when there is a significant degradation in the safety basis for the facility. Furthermore, the seismic requirements of Executive Order 12941 shall be addressed. *EO 12941 addresses evaluation of existing facilities to estimate mitigation cost estimates for seismic safety. Estimate implementation is through Federal Emergency Management Agency (FEMA).*

If any of the conditions above are satisfied then the contractor/operator shall establish a plan for evaluating the affected systems, structures and components. The plan shall incorporate a schedule for evaluation taking into account programmatic mission considerations and the safety significance of the potential failure of systems, structures and components due to natural phenomena.

If the evaluation of existing systems, structures and components identifies natural phenomena mitigation deficiencies, the contractor/operator shall establish an upgrade plan for the affected systems, structure and components. The upgrade plan shall incorporate a prioritized schedule for upgrading the systems, structures and components. The upgrade plan shall address possible time or funding constraints as well as programmatic mission considerations.

#### Section 4.4.4 Natural Phenomena Hazards Assessment

The design and evaluation of facilities to withstand natural phenomena shall be based on an assessment of the likelihood of future natural phenomena occurrences. The natural phenomena hazards assessment shall be conducted commensurate with a graded approach and commensurate with the potential hazard of the facility.

For new Sites; natural phenomena hazards assessment shall be conducted commensurate with a graded approach to the facility. Site planning shall consider the consequences of all types of natural phenomena.

For existing sites; if there are significant changes in natural phenomena hazards assessment methodology or site specific information, the natural phenomena hazards assessment shall be reviewed and shall be updated, as necessary. A review of the natural phenomena hazards assessment shall be conducted at least every 10 years. The review shall include recommendations to DOE on the need for updating the existing natural phenomena hazards assessments based on identification of any significant changes in methods or data.

### **Structures, Systems and Components (SSC) Safety Classification.**

DOE Standard 1022-94 Natural Phenomena Hazards Site Characterization Criteria, General Requirements:

The meteorologic, hydrologic, geologic, seismological, and geotechnical characteristics of a site and its environs shall be investigated in sufficient scope and detail to provide reasonable assurance that they are sufficiently well understood to permit an adequate evaluation of the proposed or existing site, and provide sufficient information to support the evaluations required by other DOE standards (e.g. DOE-STD-1023 and DOE-STD-1020, etc) for implementation of NPH mitigation requirements specified in DOE Order 420.1 (page 6, paragraph 4.A)

For sites containing facilities with SSCs in only Performance Category 1 or 2 (see below), at a minimum, sufficient site information shall be collected so that NPH assessment (DOE-STD-1023-95) and the design and evaluation of the facilities (DOE-STD-1020-2000) can be conducted by following the procedures provided in model building codes or national consensus standards (e.g., FEMA 368 and IBC 2000) (page 6, paragraph 4.3).

DOE sites are encouraged to develop a site wide NPH database that can be referenced by facility specific SARs. Such an approach would minimize the amount of written material that would be required in individual SARs (page 7, paragraph 4.G).

### **NPH Performance Categorization.**

DOE Standard 1021-93 Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems and Components, Purpose:

To provide, for the purpose of Natural Phenomena Hazard (NPH) design and evaluation, criteria for selecting Performance Categories (PCs) of structures, systems, and components (SSCs) in accordance with the requirements specified in DOE Order 420.1 and the NPH Guide to DOE Order 420.1 (page 1-1, section 1.1 (a)).

Performance Category 1: An SSC that is not covered in paragraph 2.4(b), 2.4(c), and 2.4(d) above shall be placed in preliminary Performance Category 1 (PC-1) if any of the following conditions apply:

- (i) It is a building/structure with potential human occupancy.
- (ii) The SSC's failure may cause a fatality or serious injuries to in-facility workers.
- (iii) The SSC's failure may cause damage that can be prevented or reduced cost-effectively by designing it to withstand NPH effects.  
(page 2-5, section 2.4 (e)).

#### System Interaction Effects ("Two over One Protection")

An SSC that has been placed in a preliminary performance category in accordance with the basic categorization guidelines of Subsection 2.4 (designate it as a "source") shall have appropriate NPH mitigation requirements as provided in paragraphs (b), (c), and (d) below, if its behavior by itself, or the multiple common cause behavior of it with other SSCs may adversely affect the performance of other SSC (designate as "target"). These additional requirements will depend on the type of source behavior that causes adverse interaction with the target during or following an NPH event (page 2-5, section 2.5 (a)).

*(A Revised NPH Requirement of Source SSC shall be determined. A Revised NPH Requirement of Source SSC of PC-1 seems to be reasonable from information in DOE documents as well as comparing provisions of National Earthquake Hazards Reduction Program (NEHRP) indicating a Seismic Performance Category A defined as a low occupancy buildings in areas of minimal seismicity. Buildings in this category would not have to meet specific seismic requirements but only be constructed of good-quality materials and have structural parts securely tied together and anchored to the foundation.)*

#### **NPH Design, Analysis Methods and Criteria.**

DOE Standard 1020-2000, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities. Chapter 2, Earthquake Design and Evaluation Criteria.

##### Introduction

This chapter describes requirements for the design or evaluation of all classes of structures, systems, and component (SSCs) comprising DOE facilities for earthquake ground shaking. These classes of SSCs include safety class and safety significant SSCs per DOE-STD-3009-94 and all SSCs per the International Building Code 2000 (IBC 2000) and other codes with seismic provisions comparable to NEHRP provisions. This material deals with how to establish Design/Evaluation Basis Earthquake (DBE) loads on various classes of SSCs, how to evaluate the response of SSCs to these loads, and how to determine whether that response is acceptable (page 2-1, paragraph 2.1). *(This standard is to be used by a professional to determine the above.)*

## References

1. DOE Order 420.1, Facility Safety, 5-20-02.
2. DOE Standard 1020-2002, Natural Phenomena Hazards Design and Evaluation Criteria For Department of Energy Facilities, January 2002.
3. DOE Standard 1021-93, Natural Phenomena Hazards Performance Categorization Guidelines For Structures, Systems, and Components, July, 1993.
4. DOE Standard 1022-94, Natural Phenomena Hazards Characterization Criteria, January 1996, reaffirmed errata April 2002.
5. DOE Standard 1023-95, Natural Phenomena Hazards Assessment Criteria, September 1995.
6. DOE Standard 1024-92, Guidelines For Use Of Probabilistic Seismic Hazard Curves At Department Of Energy Sites For Department Of Energy Facilities, January 1996.
7. Executive Order 12699, Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction, January 5, 1990.
8. Executive Order 12941, Seismic Safety of Existing Federally Owned or Leased Buildings, December 1, 1994.
9. FEMA IS-8, Building For The Earthquakes Of Tomorrow, March 1995.
10. FEMA 368, NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings and Other Structures.
11. HFBR SAD (Draft), Chapter 1, RSC, October 1999.
12. IBC, International Building Code.
13. ICSSC RP 5, ICSSC Guidance on Implementing Executive Order 12941 on Seismic Safety of Existing Federally Owned or Leased Buildings, October, 1995.
14. RHIC SAD Appendix 22, DOE Accelerator Order 5480.25 Implementation Plan For Brookhaven National Laboratory Material Phenomena Hazards Evaluation, Revision 1, June 28, 1999.
15. RHIC SAD Chapter 3.S Design Criteria For Natural Phenomena Hazards, Revision 1, June 28, 1999.